SUSTAINED SPACE SUPERIORITY:
A National Strategy for the United States

by
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A National Strategy for the United States

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Preface and Acknowledgments

This paper outlines a national strategy to sustain U.S. superiority in space. While it would be desirable to avoid placing weapons in space, attempts to restrict weapons or outlaw warfare have historically failed. For this reason, the United States should take the necessary steps to sustain its current position of superiority in space by preparing for the eventuality that weapons will be used in space. At the same time, the United States has made little progress toward developing launch vehicle technology over the past twenty years. Yet, achieving reliable and affordable access to space is a critical element in achieving space superiority. To improve the nation's position, the four national space sectors (military, intelligence, civil, and commercial) must be coordinated to develop a comprehensive national strategy for the United States to achieve sustained superiority in space.

In conducting this research, I would like to express my appreciation to my Air War College faculty advisors Dr. Grant Hammond, Colonel (Ret) Theodore Hailes, and Lieutenant Colonel Tom Walker for their invaluable encouragement and assistance. I would also like to express my thanks to Colonel Katherine Roberts for her leadership and vision of space for the United States Air Force. Finally, I would like to express my thanks to my wife for her constant support and understanding. That being said, the author alone is responsible for the contents of this study.

Abstract

The increasing importance of space for U.S. national security requires the nation to protect its interests by sustaining a position of space superiority. The forces of globalization are forcing the United States to move away from its historical stance of maintaining space as a sanctuary toward the concept of using weapons in space. The United States must prepare sufficient "bridges" to make the transition to using weapons in space in view of psychological impediments and treaty obligations, which must be orchestrated to support and protect the current uses of space while preparing for eventual conflict in space.

This study examines a framework for organizing U.S. space activities into a coherent national strategy sustained space superiority. It analyzes several dimensions that affect a national strategy for U.S. space superiority, including its military, intelligence, and economic components. This national strategy for space superiority will require strong leadership and public support because this strategy will be expensive and involve a long-term commitment. While the United States enjoys space superiority today, this advantage will be lost if the nation does not take the necessary steps to sustain it.

The Author

Lieutenant Colonel Larry J. Schaefer, USAF, is an aerospace engineer with experience in both classified and unclassified military space programs. Before attending the Air War College, he was a program manager in the Space Based Infrared Systems Program Office at the USAF Space and Missile Systems Center, where he developed the acquisition strategy for the low earth orbiting component of the Space Based Infrared System, and supported the Milestone-I decision by the Undersecretary of Defense for Acquisition, Technology, and Logistics. He served in the National Reconnaissance Office's (NRO) Launch Program Office, where he worked as a launch integrator for classified satellites and served as chief of the Advanced Program Acquisition and Development Branch where he supported strategic studies for the NRO's future launch activities. He held various positions at the USAF Space and Missile Systems Center, including in the MILSATCOM Joint Program Office where he managed the ground test of the first Milstar communications satellite, and the Space Test Program where he worked on Department of Defense experiments for four Space Shuttle missions. His first assignment was with the Flight Dynamics Laboratory at Wright Patterson Air Force Base, where as an aerospace engineer he conducted analysis on high-speed aircraft and hypersonic programs, such as the National Aerospace Plane, conducted research on advanced launch systems, and published papers on reusable launch vehicles. He is a graduate of the Squadron Officer School, a distinguished graduate of Air Command and Staff College, and Defense Systems Management School. He earned a Bachelor of Science from the University of Colorado, and a Master of Science from the University of Southern California.

I. Introduction

This study proposes a national strategy for the United States to create space superiority and prepare for the eventuality of using weapons in space. This strategy identifies a comprehensive set of steps that are suitable for action that should move the United States toward sustained space superiority.

The first step is to establish what is meant by "superiority."[1] For the purposes of this study, superiority includes not only military dominance over an adversary, but also dominance in the commercial and civil space domains. Dominance in these areas is required to support the industrial base and provide the expertise and experience necessary for the United States to sustain space superiority. The use of the term superiority subsumes the military concept of space control.[2]

There is an interdependent relationship between these two items – sustained national space superiority provides the necessary elements for the military to conduct space control, and space control is required for sustained national space superiority. The United States must accept the inevitability that the increasing importance of space will make it a lucrative target during future conflicts and compel the United States to defend its interests there. This study discusses how national and international forces will eventually cause the United States to put weapons in space, and take the steps needed to ensure the nation is prepared for adversarial attempts to deny our use of space.

While these events may not occur for years or decades, they are likely to happen. The timing of U.S. actions will be influenced by the threat, the risk that the nation is willing to absorb, and how much the nation is willing to spend. A national space strategy must be consistent with economic and political realities, but a comprehensive, flexible strategy able to adapt to changes and respond to changing threats at acceptable levels of risk, will be expensive.

National strategies are complex entities that involve actions among many dimensions to be effective and successful. For this reason, military strategists have analyzed strategy by breaking it into various components, of which the works by Karl von Clausewitz and his description of the

elements of strategy are noteworthy examples.[3] Colin Gray, in his book *Modern Strategy*, describes the dimensions of strategy that he organizes into three categories, as shown in Table 1, and examined in greater detail in Section III.[4]

People/Politics	**Preparation for War**	**War Proper**
People	Economics and Logistics	Military Operations
Society	Organization	Command
Culture	Military Administration	Geography
Politics	Information and Intelligence	Friction
Ethics	Strategic Theory and Doctrine	The Adversary
	Technology (and Acquisition)	Time

Table 1: Dimensions of Strategy[5]

While Gray's approach is designed for national strategies for war, these can be expanded and adapted to provide a national strategy for sustained space superiority. This study discusses a comprehensive national strategy for space superiority by using this framework for strategy, and argues that the United States lacks a comprehensive strategy for guiding it toward space superiority and the weaponization of space.[6] While attempts are often made to compare the current space situation with the early days of the Army Air Corps as it struggled to develop strategic bombing theory, doctrine, and an independent Air Force, achieving sustained space superiority will require a different strategy.[7] Just as the early air power strategists did not rely simply on ground or sea theory and doctrine, there are perils if a space strategy relies on the analogy of strategic bombing.

Developing a national space strategy requires an evolutionary or incremental approach, which provides multiple opportunities for the U.S. leadership to assess progress and change strategy. Not only is an evolutionary approach more economical, given how expensive space superiority will be, but incremental progress will allow the United States to develop near term capabilities that will minimize the risk of being denied the use of space. Finally, this allows United States the time for the political, economic, and technological dimensions of space to mature.

With these thoughts in mind, this study discusses three principal topics. The first are the difficulties that the United States is likely to encounter as it moves toward space superiority, which could include the deployment of weapons in space. Although space has been used for military purposes for years, the current national attitude is that space should remain free of weapons and warfare.[8] Further, the American public and commercial space industry still consider space as a sanctuary, and the United Nations supports this concept of the peaceful use of space.[9] Today, the United States enjoys space superiority because no nation has been able to deny our ability to use space.[10] Recent U.S. space policy addresses the need for controlling space, which the Bush Administration identified as an important element of future defense activities. Nevertheless, the prevailing mindset in the United States and the international community is that space should remain a sanctuary that is free of weapons.[11]

The second section describes the pressures that are forcing the United States to reconsider whether space must be preserved as a weapons-free sanctuary. The argument in this study is that the United States has a responsibility to protect its assets in space, and must start planning now for that eventuality. A number of recent incidents, some of which have been addressed in the United Nations, suggest that states are already interfering with normal satellite operations.[12] Thus, without assets to defend our systems, the United States' current space superiority may be fleeting.[13]

The third section examines several dimensions of strategy to outline a framework for understanding how the United States might move toward space superiority. Given the current political climate, the United States is unlikely to cross the threshold of weaponizing space unless there is a significant provocation that attempts to prevent the United States from using its space systems, or if a state uses space weapons against the United States. While the reasons why the United States might place weapons in space vary, the broader point is that the nation should develop a national strategy for space superiority that identifies the actions that are necessary for a smooth transition. Furthermore, it is essential for these actions to be taken before an adversary prevents the United States from acting.[14]

II. The Allure of Sanctuary

Since the earliest days, U.S. space activities have been shaped by the desire to keep space free of weapons, which was evident when societies worried about nuclear weapons, anti-satellite weapons (ASATs), and missile defenses. While the political climate may change as the Bush Administration accelerates activities for national missile defense, significant changes will be required before the United States moves to develop weapons for space.

The historical U.S. position that space should be used for peaceful purposes originated in the Eisenhower Administration's "Open Skies" policy. The intent of President Eisenhower's policy was to establish the "concept of freedom of international space," and to divide the U.S. space program into military and civilian agencies.[15] The civilian agency, National Aeronautics and Space Administration (NASA), established an open and cooperative space program in contrast with the closely guarded Soviet space program.[16]

After the Soviet Union's launch of Sputnik in October 1957, the Soviet Union had effectively taken the lead in space technology. The United States, however, continued to emphasize that space should be preserved for peaceful purposes, while the United States sought to establish its superiority in space technology. The Kennedy Administration, with its emphasis on increased federal spending for space technologies, articulated the vision of putting humans on the moon by the end of the 1960s, which had two effects. First, it provided a clear picture of what the United States can achieve when its leadership and people are unified in their support of a program. Second, it effectively centralized most of the U.S. space program in a civilian agency, which steered the U.S. space program toward peaceful purposes.

As it fought to regain technical superiority, the United States continued to reaffirm the nation's commitment to ensuring that space is used peacefully by all nations.[17] It is important to note this policy reflected the view that space should be used for peaceful purposes, and reaffirmed that the United States will ensure that its ability to use space is

not denied by others.[18] Two significant events that contributed to the "space as sanctuary" mindset are anti-satellite (ASAT) programs and the Anti-Ballistic Missile treaty as it pertains to national missile defense.[19]

Nuclear weapons had a significant influence on President Eisenhower's decision to develop U.S. capabilities for detecting Soviet nuclear activities through the unrestricted use of space for surveillance and reconnaissance. As reflected in the "open skies" approach to verifying nuclear activities and providing missile launch warning, this peaceful use of space mindset helped to stabilize nuclear relationships.

U.S. efforts to produce an anti-satellite (ASAT) system date back to the 1950s when visions of Pearl Harbor were still fresh in many minds.[20] The initial concept was to develop a class of weapons to ensure the United States was not surprised by an attack in space. The original Eisenhower Administration program was to use air launched and ground launched systems with nuclear warheads that compensated for the inability of guidance technologies to perform the precision maneuvering necessary for intercepting ballistic missiles. In 1958, President Eisenhower made the decision to focus on a satellite "inspecting" program (called SAINT) rather than ASAT programs. While the official position was to use space peacefully, development of systems related to the initial concept continued. The U.S. Army developed the Nike Zeus system, and the United States conducted the first successful ASAT test in 1963. In addition, the U.S. Air Force deployed modified versions of Thor rockets for use as ASATs during the late 1960s. Test results of using a nuclear weapon as an ASAT suggested a high risk of collateral damage to U.S. satellites in similar orbits. This finding, in combination with a lack of ASAT threat from other nations, led to a gradual reduction in the priority of ASAT programs. During the 1960s and 1970s, ASAT efforts were of secondary importance to arms control and the Vietnam War. As a result, the Kennedy and Johnson administrations focused on passive military activities in space, and the Nixon Administration followed a similar path. In an interesting reversal, the Ford Administration pushed for advanced space systems and permitted the development of ASATs, but the Department of Defense and the Air Force were reluctant to pursue them.[21] However, the Carter Administration began an advanced non-nuclear ASAT program as a bargaining chip in arms negotiations. The Reagan Administration funded ASAT improvements, but an operational ASAT system was never deployed as a result of technical problems and cost growth. The first Bush Administration continued to support ASAT

programs but also pursued "open skies" proposals, which raised budgetary concerns for future ASAT development. The Clinton Administration pursued a passive approach toward ASATs, choosing instead to focus on deploying theater and national missile defense systems in the future.

Also contributing to the concept of space as a sanctuary are the Outer Space Treaty of 1967 and the Anti-Ballistic Missile (ABM) Treaty of 1972. The Outer Space Treaty established the principle of the freedom of use of space and legitimized the military use of space for research and development and for peaceful purposes. The legal interpretation of "peaceful purposes," which has been the subject of debates for years, was interpreted by the United States to mean the "non-aggressive" use of space. This was the preferred interpretation during the Reagan Administration's Strategic Defense Initiative program. The Outer Space Treaty also banned the placement of weapons of mass destruction (WMD) in space, which in the United States was interpreted to exclude ASAT weapons because these are not seen as weapons of mass destruction.

While the ABM Treaty has had a profound effect on the U.S. strategic mindset about space as a sanctuary, two recent events have begun to modify that view. The first was the collapse of the Soviet Union as a peer superpower. The second was the Gulf War and the associated difficulties the U.S. had in countering the Iraqi theater ballistic missiles. The first event created an uncertain environment for U.S. national security; the second caused great concern when it became apparent that the U.S. military could not defend against theater ballistic missiles.[22]

During the early 1990s, ballistic missile proliferation throughout the world became an increasing concern. Given the proliferation and the difficulties in the Gulf War, a strong push was made for defense against these theater ballistic missiles. In addition, several intelligence estimates suggested that missile technology was improving and the range of the theater ballistic missiles was increasing enough to cause concern for defense of the United States' territory.[23] The Clinton Administration worked with the Russian government to establish an agreement on the ABM Treaty to differentiate between theater and non-theater missile defense. This would allow deployment of a set of theater missile defense systems, but retain the majority of the ABM treaty. Agreements were made between President Clinton and President Yeltsin, but the United States Congress was unwilling to accept these changes without further discussion on the ABM Treaty and the planned National Missile Defense system. The Congress was pushing to rewrite the entire treaty to allow for

a national missile defense system. In fact, Congress passed a law in 1999 that stated the United States would deploy a national missile defense system as soon as technically feasible.[24] President Clinton postponed the decision to deploy national missile defenses during the summer of 2000, and left this decision for the next administration. The Bush administration, since January 2001, has moved aggressively to develop missile defenses, despite drawing harsh criticism in the international community.[25]

As these examples suggest, the United States is having difficulties moving beyond the space as sanctuary mindset. While the Outer Space Treaty and Anti-Ballistic Missile Treaty kept space as a sanctuary and reduced the nuclear threat, there is a reluctance to change these agreements. There are international efforts to maintain the Outer Space Treaty and the Anti-Ballistic Missile Treaty in order to preserve space for peaceful purposes. For example, in November 1999 the United Nations passed a resolution calling on member states to prevent an arms race in outer space on a vote of 138 to 0, with Israel and the U.S. abstaining. Whether this U.N. resolution will have any greater effect than the 1928 Kellogg-Briand Treaty that outlawed war is remains to be seen.

Another influence that keeps the United States from rejecting the space as sanctuary mindset is the view among senior military and civilian leaders that space weapons are destabilizing, and that using such weapons crosses the threshold for using nuclear weapons or other weapons of mass destruction. In January 2001, the United States Air Force conducted the inaugural "Schriever 2001" wargame in part to understand this problem and assess the value of space power in warfare.[26]

The final element that keeps the United States from moving away from the space as sanctuary mindset is American politics, notably the idea that space should be available to all nations for peaceful purposes and for the benefit of all humanity, which is consistent with the historical American position on the freedom of navigation on the high seas.[27] The American public may not be ready for weapons in space even if they believed that these weapons would be used only to defend U.S. territory or vital interests. A complicating factor is that space superiority and weapons are so costly that the nation will require significant support from the public.

The allure of the space sanctuary mindset is real and must be acknowledged and addressed for the proposed national strategy. To help

the success of the strategy, the United States needs to leverage the dynamic forces that are causing a change to this mindset.

III. Importance of Space Superiority

The United States is very dependent on space for multiple aspects of its national security. The following section addresses how the United States depends on space for commerce and military activities. It describes how the dependence on space is growing at an extraordinary rate, which is likely to continue for many years. During the 1990s, the United States and the world gravitated towards an interconnected global economy. This condition was termed globalization and is described by Thomas Friedman in his book, *The Lexus and the Olive Tree.*[28] The significant increases in communication capabilities and the proliferation of computer power changed the face of the world. The Tofflers identified this era as a new wave in the way commerce is conducted and wealth created.[29] Tremendous changes have occurred in the past decade and the United States is trying to adjust to and leverage these changes.

Military Pressures

Military pressures to move away from the space as sanctuary mindset are likely to mount as U.S. national security is reshaped to fit a newly globalized world. The Bush and Clinton administrations adopted policies that made computer and communication capabilities available to the American population. These administrations also included the need to leverage information technologies in their *National Security Strategies*.[30] Since the *U.S. National Security Strategy* depends on worldwide knowledge and access, the United States relies heavily on commercial and military space systems.[31]

The United States Department of Defense addressed its strategy for supporting these elements in *Joint Vision 2020* and the *National Military Strategy*, both of which depend on information dominance and knowledge management to improve U.S. decision-making capabilities in war.[32] To achieve this, the U.S. military will require robust sensors that can generate

and process enormous amounts of data as well as communication capabilities for getting that data to processing centers where it can be transformed into militarily useful information and knowledge. Since we do not know when or where the next conflict will occur, sensors will require immediate access to all parts of the world, and similarly, global communications systems will be required to support these sensors. For these reasons, placing sensors and communications systems on satellites clearly supports these requirements. Just as the military will rely on space for these capabilities, the same will be true for commerce. Accordingly, the United States will need to protect its space platforms that support commerce and national security. There are many recent examples that demonstrate the growing U.S. dependence on space assets, including the Persian Gulf War and the use of space assets in the Balkans and Kosovo.

The Persian Gulf War was the first space and information war in terms of the U.S. reliance on space assets and information technology for reconnaissance, weather, communications, and precision navigation. In fact, the U.S. Air Force continues to update its doctrine and theory of air power based on these efforts and military operations conducted in Kosovo. While NATO efforts in Kosovo were limited to air power, the emphasis on air power highlighted the advantages associated with space capabilities and that space was critical to NATO and U.S. efforts.

The demand for near real time information puts pressure on the United States to shift from the space as sanctuary mindset to one of sustained space superiority. The pressures of a globalized world will increase the dependence of theater combatant commanders on information and communications to support military operations. Since U.S. national strategy depends on space systems, the United States is likely to need space control if it is to protect critical information and deny that information to adversaries.

Other states have noted that the U.S. dependence on space systems is increasing. For example, Chinese officials have described space as a critical U.S. vulnerability and have identified striking at space systems as being a preferred approach for countries that cannot defeat the United States with conventional weapons. A paper supporting the Commission to Assess United States National Security Space Management documents additional threats that are forcing the United States to shift from a space sanctuary mindset.[33]

Commercial Pressures

While the military's dependence on space is growing, the commercial sector is increasing so rapidly that there will be additional pressures to move toward space superiority. For example, the International Space Business Council identifies the space industry as a $96 billion business that could grow to roughly $170 billion by 2005.[34] In addition, a number of U.S. companies achieved more than 100 percent growth in stock price during 1999 when the Iridium satellite communication system declared bankruptcy and was rejuvenated as a commercial venture.[35] The first company to orbit a one-meter resolution imaging satellite was Space Imaging on September 24, 1999. It plans to capture thirty to forty percent of the commercial imagery market, which is estimated to be more than $6 billion per year by 2007 and growing at an annual rate of thirty-four percent.[36] Recent decisions by the U.S. government to allow commercial firms to sell one-half meter resolution satellite imagery are generating a commercial sector that has extraordinary potential for growth. The International Space Station creates possibilities for other potential revenue producing space applications, such as medicine and biological processing.

However, the growing dependence on space for commerce and national security means that the United States should prepare soon to protect its assets in space. For example, communications satellites have already been deliberately disrupted--Tongasat was jammed because of disagreements over possession of a geosynchronous orbit slot.[37] Germany and China have developed "inspector" satellites. Germany developed its satellite in a partnership with Russia to inspect the MIR space station for damage. While the satellite failed to complete its mission, most of the technology necessary for performing operations near other satellites was demonstrated, and these same technologies can now be used to disrupt U.S. satellites.[38]

One satellite constellation that is susceptible to disruption is the Global Positioning System (GPS), which provides precise time and location information for global commercial, civil, and military users. For the military, these satellites supported precision bombing and navigation in the Persian Gulf War and Kosovo. The civilian community is highly dependent on GPS signals for aircraft and maritime navigation, and

commercial applications range from navigation for recreational boating to electronic map functions in rental cars to establishing the timing signal that is necessary for worldwide telephone networks. The combined revenue for these commercial applications was estimated at $7.3 billion in the year 2000, and is expected to exceed $16 billion per year by 2005.[39] In view of the importance of GPS satellites to U.S. national security, and the fact that that satellite signals are susceptible to jamming explains, in part, the U.S. Air Force's GPS modernization program that seeks to reduce the vulnerability to jamming.

For these reasons, the GPS system is an important example of the difficulties associated with shifting from the ‘space is a sanctuary’ mindset. The GPS program is moving into the commercial sector, as a result of President Clinton's decision to provide the more precise military GPS signal to all users, which was motivated by commercial and civil pressures.[40] At the same time, there have been discussions about shifting the management of GPS from the U.S. Air Force to the civil sector.[41] Thus, the pressures of globalization are changing the relevance of the space as sanctuary mindset that dominates U.S. policy. The following section examines a framework for evolving a national strategy for space superiority.

IV. Framework for National Strategy of Space Superiority

People/Politics	Preparation for War	War Proper
People	Economics and Logistics	Military Operations
Society	Organization	Command
Culture	Military Administration	Geography
Politics	Information and Intelligence	Friction
Ethics	Strategic Theory and Doctrine	The Adversary
	Technology (and Acquisition)	Time

Table 2: Dimensions of Strategy

This section discusses a proposed national strategy for sustained space superiority, which draws on the dimensions of strategy that are described by Colin Gray in *Modern Strategy.* This discussion, which is organized into three sections that examine the dimensions of "people/politics," "preparation for war," and [the conduct of] "war proper," is designed to establish a framework for understanding some of the issues that are consistent with U.S. superiority in space systems and capabilities.

People and Politics

To begin with, it is important to address the role of leadership in the development and execution of the proposed national strategy, which includes the influence of people, society, culture, politics, and ethics on national strategy.

People. As with any aspect of national strategy, strong leadership is required for success, which is the case for a national strategy for sustained space superiority whose success depends on coordinated efforts between military, civilian, and commercial space activities. The necessity of strong presidential leadership was a key finding by Congressional Commissions.[42]

These coordinated efforts depend ultimately on four aspects. First, the executive branch must create the vision, communicate it, and unify efforts to achieve that vision. Second, there must be strong leadership from the President and close coordination with cabinet members and agency leaders who are involved in space. Third, the President must motivate the American people to support the space superiority vision, and fourth, the executive branch must work with the legislative branch to communicate the details of the vision and the necessary funding. However, the problems associated with supporting this strategy are significant when there is no unifying threat.

To succeed, this vision must proceed on an evolutionary basis.[43] To begin, the United States must reverse the declining number of technical degrees that are awarded to U.S. citizens. According to the National Science Foundation, more students were graduated in 1996 with degrees in physical fitness than in electrical engineering.[44] In addition, the United States ranked ninth in the world in terms of the percentage of engineering bachelors degrees awarded in 1997, which is several multiples less than Asia and Europe.[45] All four space sectors require technically educated personnel, and they will compete with other business sectors (entertainment, electronics, telecommunications, etc…) for this workforce. The fundamental point is that the United States must produce a larger and more technically educated workforce if it is to maintain economic prosperity and technological superiority in space systems.

Society. The success of a national strategy for space superiority will require the support of American society given the significant resources that will be required for space superiority. The nation's leadership must articulate compelling reasons for the society to spend discretionary funds on space-related activities. Such rationale would include physical protection of the nation and the people, protection of revenue generating sources, improve the U.S. standard of living as a result of technological progress, and thus reap benefits for future generations. President Clinton used similar arguments when he supported funding for the International Space Station.

The leadership of the United States must convince the American society that it is their interests to prepare a long-term plan for placing weapons in space in order to defend U.S. interests in space. As threats to those interests increase, the United States must build broad societal support for a strategy of space superiority.

Culture. Culture is an important component of strategy because it influences how people behave and how ideas and practice interact.[46] Many authors have explored the concept of strategic culture and its implications for a national strategy of space superiority. An understanding of U.S. strategic culture may provide insights on how best to create a national strategy for space superiority.

Since the underlying mindset that space should remain a sanctuary reflects American strategic culture, the U.S. leadership must work within this culture to properly present the national strategy to gain the support of the American people, particularly since the cost of a national space strategy will be high. To do this, the leadership must follow a national strategy that has strong support of commercial space activities.

At the same time, the U.S. military is reevaluating the concept of space as a sanctuary. Observers at several war games have seen the effects of the sanctuary mindset, particularly when game participants denied requests for using space weapons in view of their potentially destabilizing effects and the belief that adversaries might respond with nuclear weapons. The Commission to Assess United States National Security Space Management and Organization identified the need to improve space personnel and develop a space culture, specifically, the need to "create and sustain a cadre of space professionals" and to "develop a military space culture."[47]

The non-military space sectors also are influenced by cultural tendencies. For example, NASA did not protect its communications to such highly valuable assets as the Hubble Space Telescope. As another example, the commercial sector resists placing warning sensors on the commercial satellites that provide critical communications services or that provide important commercial support to major financial institutions. In addition to the added cost of doing so, the reasons are as much economic as operational. Notably, the added weight of adding these warning sensors reduces fuel or other revenue generating items, such as communications transponders.

Politics. The political dimension also influences the nature of national space policy, defense space policy, civil space policy, and commercial space policy. These policies must address how the various space sectors are coordinated and how the sectors will work together to

solve the difficult problems. Externally these same policies must address the fears of allies, neutral countries, and adversaries.

The U.S. national space policy, which was signed in September 1996, addresses both space sanctuary and space superiority in terms of promoting the ideal of using space for peaceful purposes and ensuring that the United States can protect that ideal. This policy also supports a balanced national space program that "serves our goals of national security, foreign policy, economic growth, environmental stewardship, and scientific and technical excellence."[48] This policy also addresses guidelines for international cooperation, space transportation, earth observation, nonproliferation, export controls, and technology transfer, arms control, space nuclear power, space debris, and government pricing policies.[49]

While U.S. national space policy covers a comprehensive array of factors, this policy is not sufficient or internally consistent enough to achieve sustained space superiority. For example, while the Clinton Administration actively supported commercial space companies in order to open new international markets, Congress imposed restrictions on these commercial activities given funding raising scandals involving Chinese attempts to gain access to U.S. nuclear and space technologies. This example highlights the need for greater cooperation between the executive and legislative branches to successfully execute a national strategy for space superiority.

The United States Department of Defense updated its 1987 Defense Space Policy in July 1999. This update contained several major themes that are critical to a national space strategy.[50] One theme is to develop greater reliance on commercial space systems in the areas of communication and imaging satellites.[51] In the case of the latter, President Clinton's Presidential Decision Directive 23 encouraged the use of commercial satellite imagery. For example, commercial satellites provide roughly ninety percent of the Department of Defense's communications, and Congress has encouraged the use of commercial space systems to meet military and intelligence requirements.[52] The Department of Defense space policy also covers such areas as space architecture planning, acquisition, science and technology, demonstration and experimentation, use of models and simulations, and education and training. Since statements in these areas reflect current efforts rather than establish a far-reaching vision, the strategy for sustained space superiority needs to be improved.

The current state of the U.S. civil space policy is outlined in the National Aeronautics and Space Administration's Strategic Plan 2000. This plan discusses the near-term priorities, long-term investments, and a vision for expanding the frontiers of air and space.[53] This document also describes a framework for interactions between NASA and other national agencies.

The current state of U.S. commercial space policy is captured within the U.S. National Space Policy, various Presidential Directives, and Congressional legislation. The National Space Policy identifies the fundamental goal of U.S. Commercial Space Policy, which is to support and enhance U.S. economic competitiveness. U.S. Government agencies are directed to purchase commercial space products to the fullest extent possible, refrain from activities that would harm the commercial industry as well as refrain from using direct government subsidies, and create free and fair trade agreements in the areas of commercial communications, space launch, and imagery systems.

Ethics. The ethical dimension has important implications for a U.S. national policy that governs the different space sectors, specifically, how military efforts to develop and employ weapons in space is influenced by existing space treaties and international laws. The only current restriction to weapons in space is that weapons of mass destruction are not allowed. Keeping this restriction should be a cornerstone of U.S. space policy.

In addition to the weapons of mass destruction issue, weapons that transit through space (ballistic missiles), the placement of weapons in space to protect space assets (orbiting anti-satellite weapons), and the use of weapons in or from space all have significant ethical ramifications. There are growing concerns about weapons that destroy satellites and thereby create space debris. There are related fears that such weapons could strike ground targets. Finally, issues associated with placing weapons in space must be addressed from an ethical standpoint as part of a comprehensive strategy for the United States.

Preparing for War

There are many factors that influence a national strategy for sustained space superiority. This section examines those that involve the preparation for war, notably economics and logistics, organization,

military administration, information and intelligence, strategic theory and doctrine, and technology and acquisition.

Economics and Logistics. There is no doubt that a strategy for space superiority will be expensive, despite the fact that space systems have the ability to generate significant revenues. The United States must develop more cost effective space systems, and accordingly, the U.S. Air Force Research Laboratory has identified two barriers future space systems must address: affordability, and the time it takes to bring systems and technologies to market. The first barrier consists of three items: power, aperture, and launch. Since rapid advances in these technologies have historically outpaced the design cycles of satellite systems, one implication is that the communication and computational capabilities of many satellites are outdated.

The fundamental problem for reducing the cost of operating in space is the cost of launching satellites, which currently is roughly $10,000 per pound.[54] Most studies indicate that affordable access to space will require costs of less than $1,000 per pound.[55] This need for significant reduction in cost has unified the efforts of many organizations that are involved in space activities. Since affordable access to space is one of the primary keys for a national strategy of space superiority, the United States will not gain space superiority if it cannot afford to put payloads into orbit in a routine and inexpensive fashion.

Of the numerous studies on space launch that have been conducted, two that are particularly significant are the 1994 Space Launch Modernization Study conducted by the U.S. Air Force and the 1999 Space Launch Vehicles Broad Area Review. The Space Launch Modernization Study investigated both military and civil requirements for space launch and assessed the current commercial market. It also developed a comprehensive database with the purpose of fostering consensus among the participating agencies on what the United States must do to improve its launch capabilities. Accordingly, the study group developed four options for modernizing the United States space launch capabilities, and concluded that the space launch market could sustain only one U.S. company. It recommended that the Air Force pursue an expendable launch vehicle that evolved from the currently existing launch vehicles, which became known as the Air Force Evolved Expandable Launch Vehicle program. In addition, the study recommended that the National

Aeronautics and Space Administration develop a reusable launch vehicle.[56]

The underlying objective of all these recommendations is to reduce the cost of space launch. For example, the stated goal of the EELV program is to "partner with industry to develop a national launch capability that satisfies both Government and Commercial payload requirements and reduces the cost of space launch by at least twenty-five percent."[57] Much of NASA's RLV focuses on replacing the current Space Shuttle system

The Space Launch Vehicle Broad Area Review was convened after several costly launch failures prompted President Clinton to direct the Department of Defense to review the current state of Air Force launch vehicle programs and improve the rate of success. While many of the recommendations focused on the transition from current launch vehicle systems to the EELV, it also recommended that the government and industry establish a better relationship in order to improve the quality of launch vehicles.[58]

Another aspect of making space launch more affordable is to reduce the cost of activities at launch sites. Historically, the space launch ranges were maintained by the government, which effectively subsidized commercial satellite launches. However, as government budgets declined, commercial firms were charged for government support until recent efforts to privatize the launch ranges and reduce the number of personnel required for satellite launches. While these efforts reduce the cost of launching satellites, significantly greater efforts in developing advanced technologies are needed before the United States will be able to meet the requirement of space launch that costs less than $1,000 per pound of payload into orbit.

The key to efforts to make space systems more affordable is to rely on commercial research and development and make satellites smaller and easier to produce in large numbers. The commercial sector made significant advances during the early 1990's. While Hughes was the first company to seriously consider the mass production of satellites, other aerospace companies are now producing large numbers of satellites. Continued improvements are needed. One effort to support his process is the U.S. Air Force's Lean Aerospace Initiative with participation by most companies interested in the business of space.[59]

Several studies have identified the difficulties associated with supporting defense needs by the commercial space sector.[60] The ability to

rely on the commercial space sector to support defense needs requires a set of policies that allows, even encourages, industry to invest in the necessary technologies. This requires Congress to support the transfer of critical space technologies to foreign customers and partners, something many have been reluctant to do in recent years.

At the same time, logistics is crucial to space systems. On one level, the economics of space systems makes it imperative for government agencies and commercial firms to consider the logistics associated with of space systems. With satellites, the operations and maintenance components of life cycle costs are usually less than traditional transportations systems (e.g., trucks, aircraft, etc...). However, the logistics associated with maintaining the software in space systems is significant. Since most satellites are not available for hardware maintenance, software becomes the key -- critical to the health and status functions as well as mission data communication and processing functions of a satellite. All of these are software intensive in terms of satellite development, production, testing, and operations. In addition, satellite systems are becoming more software intensive as they are being designed for software maintenance and upgrades. Thus, the ability to develop satellite systems with adequate capability and flexibility is essential to developing robust space systems.

Organizational Dimension. The organizational aspect has significant near-term implications if the United States is to successfully develop a national strategy for sustained space superiority. While the military organization for space activities currently parallels that for the aircraft industry, the United States must recognize that space is so different that the military must be able to organize and operate in ways that allow it to accomplish its missions.[61]

The history of national space activities has been characterized by friction between the executive and legislative branches. For example, when Congress created the Civil-Military Liaison Committee and the National Aeronautics and Space Council in 1958, the intent was to create a stronger role for the military in space, despite the fact that the Eisenhower Administration emphasized a strictly civilian enterprise. One of the most significant changes in the organization of space activities occurred at the end of the Reagan Administration when Congress passed a law creating the National Space Council. Later, President George H.W. Bush officially established this cabinet-level organization and used it effectively during his Administration in the areas of civil and commercial remote sensing,

space transportation, space debris, federal subsidies of commercial space activities, and the space station.[62]

When the Clinton Administration decided that national space activities did not require the National Space Council, those functions were shifted to the National Science and Technology Council in the White House Office of Science and Technology Policy as part of its efforts to use gains in information and computer technologies to support space activities. However, it is imperative for the United States to reestablish an organization, such as the National Space Council, to serve as the focal point for implementing a national space strategy that encompasses all four space sectors (military, intelligence, civil, and commercial).[63]

There have been organizational changes in the Department of Defense that affect the leadership and management of space. The Deputy Under Secretary of Defense for Space office was dissolved and its functions moved to the Assistant Secretary for Command, Control, Communications, and Intelligence (C3I), Under Secretary for Policy, and the services as a result of defense reform initiatives in 1998. The C3I organization also gained responsibility for computers, surveillance and reconnaissance efforts, which is consistent with the priorities established during the Clinton Administration.

For the military and intelligence space sectors, the proposed national strategy requires an organization that is established at the undersecretary of defense level with representation from the intelligence community. Similar recommendations for leadership and organization were documented in the two recent reviews directed by the Congress of U.S. space activities. One of these, the National Reconnaissance Office review, concluded that high-level organization is essential.[64] The Commission to Assess United States National Security Space Management and Organization recommended that the United States create a Presidential Space Advisory Group, as well as to create an Undersecretary of Defense for Space, Information and Intelligence (USD/SII) to focus space-related responsibilities. Another recommendation was to create a new Air Force four-star general position in the Air Force Space Command to relieve the current responsibilities of the Commander in Chief of U.S. Space Command and North American Aerospace Defense Command. It also recommended the creation of an Undersecretary of the Air Force position to serve as the Air Force Service Acquisition Executive for Space and as the Director of the National Reconnaissance Office.[65] Under the leadership of the Secretary of Defense, who chaired this commission,

many of these recommendations have been carried out. Whether they will have the desired effect, and integrate space-related activities between the Department of Defense and the Central Intelligence Agency remains to be seen.

Military Administration. The concept of military administration includes, "all aspects of military recruitment, training and armament" that pertains to developing a national strategy for space superiority.[66] For space, the principal challenge is training. Three primary areas need to be addressed for training the military as part of a national strategy for space superiority.

The first area is the use of models and simulations to help military personnel adapt to the complexities of space superiority. While the use of models and simulations is not new for training personnel, the unique qualities of space are directly relevant to simulations and models. Since space is unreachable for most people, covers vast ranges, and operates in a non-intuitive fashion, simulations of space systems will help to train personnel and increase their experience. The use of models and simulations is already being used for training at specific space system training sites and general training sites, such as the Space Warfare Center and the Air Force weapons school.

Next, it is necessary to establish a space test range for realistic training in space. This is necessary to test space systems to successfully achieve sustained space superiority. The Air Force Scientific Advisory Board recommended such development for space test activity. Further, Air Force Space Command created the Space Aggressor Squadron to evaluate how adversaries might attack U.S. space systems. These training tools will be vital in the development and improvement of theory, doctrine, and strategy, including the tactics, techniques, and procedures for employing these systems that are essential to the culture and mindset for sustained space superiority.

Finally, this training is essential for establishing a space superiority culture and mindset to supersede the mindset that space must remain a weapons-free sanctuary. One effect of the space sanctuary mindset is the assumption that satellites are free from aggression. For example, satellites in low earth orbit typically pass within view of command and control antennas for roughly fifteen minutes during each orbit. During these "satellite passes," operators receive information on the health and status of satellites, and transmit commands necessary for its maintenance. If

abnormalities are detected, these are analyzed when the satellite is out of view, which provides time to gather more information for transfer to the satellite during the next pass. Importantly, the primary assumption in our daily satellite maintenance is that adversaries will not attack satellites.

This mindset must change. There are important differences in the decision cycles between offensive and defensive uses of space systems. The main difference is the shorter time available for offensive use, which reduces the time for decision and increases the need for autonomous operations, which are crucial when attacking time-critical targets. The significance of time-critical targets was first experienced during the Persian Gulf War when coalition forces sought unsuccessfully to locate and attack mobile Iraq's Scud missile launchers. A similar situation occurred during the Kosovo air campaign when it was difficult to find tanks that were obscured by foliage. Since the ability to hit time critical targets requires a brief decision cycle, future space systems offer interesting capabilities for targeting mobile missile launchers. Since there would be little time for human interaction in these engagements, personnel will need significant training to prepare them to operate in short decision cycles.

The successful transition to space superiority requires a change in the underlying mindset about space. There are activities at the Air Force Space Command to prepare future leaders for the challenges of operating in space, such as the 14th Air Force Weapons and Tactics Primer.[67] Since effects-based training for air power has begun, the space community should also begin training personnel to think in terms of specific effects. While there are some technological hurdles with training personnel on detecting attacks against satellites, well-designed models and simulations can be instrumental in preparing and training personnel for space superiority.

Intelligence and Information. While space provides vital intelligence and national security information to the nation, the proposed national strategy of space superiority requires enormous amounts of accurate and timely information. The critical question is what information is required to implement this strategy.

Space assets have provided the United States with critical national security information since the beginning of the space program. The value of these capabilities gained even greater prominence during the Persian Gulf War, which is generally described as the first information and space

war.[68] While the capabilities of previously fielded space systems gave the United States and its coalition partner a significant advantage, the existence of many shortfalls motivated the Department of Defense and intelligence community to more fully integrate space systems.

To integrate space systems with information superiority, future space systems must manage vast amounts of data on a scale that is similar to the Internet. As the market emphasizes the ability to quickly leverage data and information, innovative methods for gaining this superiority must be developed – of which linking satellite systems into networks is a prominent example. Since information and space are symbiotic, and since information is gathered from and transmitted through space, an increasingly close relationship between information and space activities is inevitable.

Strategic Theory and Doctrine. Strategic theory and doctrine have significant implications for space superiority, particularly in the commercial uses of space.[69]

While there were substantial discussions about space theory and the application of space weapons in the early 1960s, in the wake of President Kennedy's challenge to reach for the moon, the focus shifted to the civil exploration of space. The notable exceptions were in the areas of nuclear deterrence, ASATs, and missile defenses.

Today, there are efforts to improve the understanding of how space systems relate to development of space doctrine. For example, the Air Force Space Command has established several organizations to address air and space as a continuum that is governed by doctrine, as is air power. Within the Air Force Space Command, the Space Warfare Center focuses on how the United States uses space, notably through its space battle laboratory, space test organization, and aggressor squadron. Air Force Space Command includes the 14th Air Force, which serves as its operations arm, which recently released an initial report on space tactics, techniques, and procedures.

Technology and Acquisition. To achieve sustained space superiority, the United States must field space systems that are planned, developed, and deployed with a common unified vision. This guiding vision must contain a doctrinal foundation for space system employment. The National Space Architect should develop this vision, and an associated common framework for procurement.

To develop interoperable systems that work together to provide the data and information necessary for United States to make decisions more quickly than its adversary, we must field space systems that are planned, developed, and deployed as a "system of systems." In the Department of Defense, the National Security Space Architect is working on space architectures that will communicate with terrestrial architectures in an effective fashion.

A critical element of information and space superiority is the correlation and fusion of data. One concept is to establish a precise time stamp and location on all data, with processors to sort and fuse the data to gain better knowledge about an event. Ideally, this correlation and fusion could combine information from infrared, electro-optical, radar sensors, and human intelligence about a target. Combining and fusing this information will require significant communication and computer processing (both hardware and software) capabilities.

The foundation provided by space systems for air, land, and sea weapon systems will give space systems great capabilities, but additional efforts are required to develop the right technologies. For example, the United States Space Command and the Air Force Space Command should develop a time-phased sequence of requirements for space superiority, which leads to weapons in space. The first step in this development and acquisition chain is a system like the Space Based Infrared System (SBIRS) program. SBIRS is a model for space superiority. The SBIRS program is designed for missile warning, missile defense, technical intelligence, and battlespace characterization. Conceived and developed as a system of systems, SBIRS combines two satellite components for three different orbital altitudes -- low earth orbit, highly elliptical, and geosynchronous – and will share a common mission control station that manages the satellites as well as processes and distributes data. This SBIRS architecture requires the different satellite systems to be interoperable and functions as a system of systems.

The SBIRS time-phased operational requirements document is another a model for space superiority because it allows the SBIRS system of systems to mature over time. It plans to incorporate new technologies. Further, it relies on planned improvements in software to improve mission performance. The planned improvement of system employment (tactics, techniques, and procedures) is designed to take advantage of these software upgrades.

Another way that SBIRS is a model for space superiority is its robust nature. Once the full constellation is on orbit, the combination of the number of satellites, different orbital altitudes, and ability to correlate and fuse data, will create a robust capability against satellite failures and attacks. If a satellite in geosynchronous orbit fails, satellites in other orbits could temporarily handle its functions, which allows SBIRS to deal with offensive attacks. Since it is difficult for an adversary to attack satellites in all altitudes, the United States would receive warning and thus have time to respond swiftly and decisively. This is an important example of space superiority.

The national strategy will be greatly enhanced with a system like the low Earth orbiting component of the SBIRS system of systems. SBIRS Low will use a constellation of networked satellites. Given the timelines for missile warning and missile defense, the SBIRS Low constellation will need to operate autonomously. This makes a constellation like SBIRS low very complex, and requires an evolutionary approach toward improving its capabilities. Extensive modeling and simulation will assist in the learning process, but actual experience with such a system would also be beneficial before launching a program like SIBRS Low. Such an opportunity recently became available.

This opportunity exists with the commercial communication system known as Iridium, which is a network of sixty-six satellites in low-earth orbit. Developed by Motorola, the Iridium program filed for bankruptcy amid public debates about whether to de-orbit the satellites given the expense of operating these satellites. However, in December 2000, the Department of Defense awarded a contract to use this constellation for U.S. military users worldwide, which provides an opportunity for the Department of Defense to learn more about operating this type of satellite constellation and incorporating these experiences into SBIRS Low. These efforts will support other future space systems, such as the space-based radar program and its test program, Discoverer II, which was cancelled in 2000 but may be rejuvenated.

A final benefit of the evolutionary approach is that the high-level review required by the acquisition system provides a mechanism for assessing whether the United States is acquiring the right systems. By periodically assessing the requirements for these systems in terms of cost effectiveness, these space systems are more likely to fit the long-range plan for achieving sustained space superiority.

The United States has used technology to dominate its adversaries throughout its history, of which nuclear weapons, stealth technology, and precision navigation are prominent examples. The national strategy for sustained space superiority will also rely on continued pursuit of improved technologies and the integration of these technologies into future space systems. Many of these technologies are being pursued in the research and development sections of the four space sectors. In the civil sector, the National Aeronautics and Space Administration and the Department of Commerce contribute to technological advances, while the intelligence sector and commercial firms push their own research and development programs.

In space, there are three categories of technology efforts that are particularly relevant to space superiority. These are: propulsion and launch technologies; technologies for improved power production, power storage, and sensor improvements; and technologies for deploying offensive space weapons.

Propulsion and Launch Technologies: While there have been many national level studies on space transportation, the United States has failed to significantly reduce the cost of launching satellites in a reliable manner. To develop this capability, the United States must develop new technologies for propulsion and high temperature materials. In the interim, the Air Force is pursuing the Evolved Expendable Launch Vehicle with the goal of reducing the cost of space lift by twenty-five percent. Within this program, the industry partners are conducting their own research to improve structural and engine technologies.

The Air Force also has some new initiatives underway, including pulse detonation technologies that could be a more efficient form of propulsion. Another promising technological area is hybrid engine technology, a technology that is promising, but thus far has been elusive. Significant resources were invested in this area when the National Aerospace Plane was being developed. Unfortunately, by the time this program was terminated, technological hurdles still remained.[70] Since then, some innovations based on Russian research have been combined with supersonic combusting ramjet efforts by the Air Force and NASA. This has led to recent breakthroughs in launch vehicle propulsion, and thus these efforts are again moving ahead slowly.[71]

Power Production, Storage, and Sensors: The second technological area consists of improved power production, power storage, and sensors for satellites. Given the difficulties in achieving cheap,

reliable launch vehicles, many satellite technologies focus on weight reduction. Reduction of satellite weight was the key goal in most space sectors throughout the 1990s. In the area of power production and storage, there are three important national efforts. The first is the recent deployment of the very large solar arrays for the International Space Station, which is the largest structure in surface area ever to be placed in space. Eventually, these arrays will produce 200,000 watts of power. Second, the Air Force is conducting research and promoting thin-film technology. Though these films lack the efficiency of conventional solar cells, they have several beneficial capabilities. They are lightweight, inexpensive, and structurally flexible, which suits many satellite applications. One of the more visionary applications of this film is a "power sail" that could create more than 100 kilowatts of power while weighing only 200 kilograms. The third area involves commercial improvements of satellite solar array production and energy storage to supply power to satellites when the solar arrays are not illuminated by sunshine.[72]

All imaging satellites require the ability to receive energy that is emitted from the source that is being sensed, which essentially involves increasing the aperture of the sensor. To avoid large and heavy structures, synthetic apertures are being developed. Among recent successes is the deep space network for NASA where sensors on various satellites are networked and fused through computer processing. This basic design, which can create artificial sensor apertures much larger than the sum of the individual satellites, has the potential to create a significant operational capability. This approach not only improves the sensor but also provides redundancy should one satellite fail.

Combining this technology with multiple small satellites can produce significant advantages for space applications. Among these are: the robustness that multiple satellite constellations provide in case of a satellite failure, the economic benefit of establishing a large production run of inexpensive satellites, and the reduction in weight of individual satellites which eases the cost and difficulty of launch.

Reducing the weight of satellites became a major focus of effort in the 1990s. Three important technology advances are allowing some revolutionary changes in satellite design for reduced weight. These are: the miniaturization resulting from advances in the computer industry, the development and improvement in strong light-weight structures using carbon fiber technology, and the increasing communications and

computation capabilities. Each of these advances provides needed improvements, but the integrated use of all has made possible large steps toward building the less expensive systems needed for the national strategy.

Space Weapons. The final technological category covers the technologies necessary for eventually deploying space weapons. Improvements are needed in both kinetic energy and directed energy weapons before either are ready to be deployed in space. One directed energy concept being explored is a space-based laser demonstrator experiment. This "on again, off again" experiment may evolve as a joint Air Force and Ballistic Missile Defense effort, as it enjoys the support of several powerful congressional members. While early in development, these technologies are the basis for future programs that promise to radically improve U.S. capabilities.

War Proper

The final dimension of a space superiority strategy is to prepare the United States for placing weapons in space.

Military Operations. Space systems provide significant support to current military operations. As the United States plans for the future, it is necessary to debate how we will use space weapons.[73] In one study, the concepts of space combat, architectures for space combat, and space combat operations are examined in terms of a "system of systems."[74] In addition, further research and debate are necessary to prepare the United States for placing weapons in space, given questions about command and control for space weapons.

Command. The Commission to Assess United States National Security Space Management and Organization concluded that creating and sustaining a cadre of military and civilian space professionals is critical to success. The first step is to provide better command structures for both military and civilians. With the proper organizational structure, new commanders will be skilled in successfully using these space technologies when the United States employs military power.

Geography. Geography has been described as "ubiquitous and permanent, yet varied in its specific influence upon particular conflicts at particular times."[75] Since the earliest days of the military space program, space was described as the ultimate high ground for supporting military operations, which proved to be true during the Persian Gulf War as well as the Bosnian and Kosovo conflicts.[76]

Friction. The important aspect of this dimension is that it is always present—military efforts are burdened with uncertainty. However, the development of space systems and information superiority is an approach for reducing uncertainty in military operations. One reason for pursuing this strategy is the uncertainty about what adversaries might attempt in the future. This uncertainty must be addressed through sound decision-making, prioritization, and good risk management.

Adversary. Since future adversaries are likely to be adaptive and creative, the United States will need to conduct strategic assessments that properly account for how the adversary could behave. This approach will rest on periodic and continuous assessments of actions taken by potential adversary actions and their implications for the United States.

Time. Time may be the least forgiving of errors, and may "rule tactically and operationally (politically and strategically, the significance of time cannot be diminished by technical advances)."[77] Earlier discussions highlighted the benefits of time when the United States uses its information superiority and rapid strike capabilities to create decisive effects on the battlefield.

V. Conclusion

It is imperative for the United States to develop and follow a national strategy for sustained space superiority in view of the increasing importance of space in U.S. national security. Strategy cannot succeed unless the nation and its leadership have realistic expectations about the value of space. As the United States increases its reliance on space capabilities, it is important to understand that the commercial revenues generated by space programs are likely to continue to grow as the civil sector engages in significant efforts to exploit space. As the intelligence and military sectors acknowledge how critical information superiority is to U.S. national security, it is essential for the United States to develop and maintain space superiority.

To implement the proposed strategy requires multiple actions. These actions were identified throughout this study and are integrated and summarized here. They are the bridges that must be put in place to allow the nation expedient passage across the threshold of using weapons in space and sustaining space superiority. The role of leadership is a common theme among all dimensions of strategy and is critical to success.

To accomplish this, the nation must have a vision, communicated by the leadership to the four space sectors. This vision must unify their efforts, and must foster consistent policies that allow each sector to contribute to the vision. These policies will require broad governmental support to establish the legal framework and funding to sustain the vision across the four space sectors. Lastly, the national leadership must motivate the American people to support a long-term commitment to a strategy of space superiority. A strategy for sustained space superiority will be expensive and will require perseverance of leadership to engage the American public and retain their support.

At the same time, the nation's leadership must develop roadmaps to guide the development of military and intelligence systems and technologies, which is the responsibility of the National Security Space Architect in the Department of Defense.[78] This strategy is necessary if we are to coordinate space activities and understand the interactions among

space systems that cumulatively create space superiority in an operational sense.

Furthermore, the President must create an advisory body on space issues with cabinet level membership to generate guidance for implementing a strategy for space superiority. In addition, the United States would benefit from better coordination among military and intelligence space efforts, and gain from improving the ability to develop and train expertise in scientific and technical fields. Beyond these organizational changes, funding for military space efforts must be organized into a major force program, which will allow better control by the executive branch and the Congress. These steps should create more stable long-term funding for the military space activities that are essential if the United States is to develop space superiority.

The expense, complexity, and political sensitivity that are associated with sustained space superiority will require the United States to develop space systems and weapons on an evolutionary basis. The first step is to improve the nation's ability to determine if U.S. space systems are under attack, which typically involves placing sensors on satellites to warn of an attack. A related step is to continue research and development of ground-based systems for space control. At the same time, the transition to space weapons must proceed on the basis of a theory and doctrine for employing space weapons.

The nation must improve its launch capability. The ability to have affordable routine access to space is a critical part of this proposed strategy. Requiring the efforts of all four national space sectors, a coordinated effort must be undertaken to reduce the weight of space systems and improve space system software. These developments must work to make space access affordable while ensuring satellites are designed such that new software can improve their capabilities once they are in orbit. The ability to network space systems provides tremendous opportunities and is key to the efforts to sustain space superiority.

Summary

The increasing importance of space to the national security of the United States clearly establishes the imperative for sustained space superiority. To ensure the strategy is viable requires the strategy to be founded in realism. It is not acceptable to pursue, or even propose, a

strategy that does not address cost and schedule considerations. Execution of the strategy cannot without realistic expectations across all of the dimensions addressed in this paper. Finally, the national strategy requires leadership capable of guiding and motivating the necessary forces to get to the four United States space sectors driving to make the strategy a success.

The United States is proceeding down a path that will continue to increase its reliance on space capabilities. From the commercial sector, the revenue generated by space programs is projected to grow for many years to come. The civil sector continues significant efforts if international cooperation for exploration and manned experimentation in space. The intelligence and military sectors have acknowledged the critical importance of information superiority, which relies on continued improvements in space capabilities. The task is clear--- the United States must prepare to sustain its superiority in space.

This preparation must build from the present. The genesis of space activities as a pursuit for the benefit of all humanity still has resonance with many Americans. The peaceful use of space for all people also captures the international attitude as is demonstrated by the recent United Nations' resolution. This "space is a sanctuary" notion is real and must be addressed by the United States leadership in a manner that does not cause the United States to appear completely arrogant in its status as the sole superpower. As the U.S. backs away from the anti-ballistic Missile Treaty, it must begin to lay the groundwork to allow the United States to defend her interests by embarking on a path for sustained space superiority and the eventual placement of weapons in space.

Notes

[1] *Department of Defense Space Policy* (Washington D.C., 1999), p. 22, http://web7.whs.osd.mil/text/d310010p.txt, December 3, 2000. The current Department of Defense Space Policy defines space superiority as, "The degree of dominance in space of one force over another, which permits the conduct of operations by the former and its related land, sea, air, and space forces at a given time and place without prohibitive interference by the opposing force."

[2] The term superiority, rather than supremacy, is a more achievable and sustainable goal, since supremacy suggests a hegemonic or monopolistic position that would require a significant increase in national funding.

3 Clausewitz, Carl von, *On War*, Edited and Translated by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976), p. 183. See also, Howard, Michael, "The Forgotten Dimensions of Strategy," *Foreign Affairs*, 57 (1979), pp. 976-86; and Gray, Colin S. *Modern Strategy* (Oxford: Oxford University Press, 1999), pp. 23-44.

[4] Acquisition is not identified specifically in Gray's dimensions, but is addressed here because the proposed strategy will require the integration of evolutionary acquisition practices if the United States is to achieve sustained space superiority.

[5] Gray, Colin S. *Modern Strategy*, pp. 23-44.

[6] Examples include the United States Space Command (USSPACE) *Vision for 2020*, which was published in February 1997; the *USSPACE Long Range Plan* to implement the vision published in March 1998; Air Force Scientific Advisory Board (SAB) *A Space Roadmap for the 21st Century Aerospace Force* published in November 1998; and the *Report of the Commission to Assess United States National Security Space Management and Organization* published in January 2001.

[7] Bell, Thomas D., *Weaponization of Space: Understanding Strategic and Technological Inevitabilities* (Maxwell AFB, AL: Center for Strategy and Technology, Occasional Paper, 1999).

[8] The "militarization of space" refers to the use of space assets to support military activities, which includes communications, precision navigation, weather reporting, and other sensor information.

[9] The "weaponization of space" refers to the placement of weapons in space, the use of weapons from space, and weapons transiting space, such as ballistic missiles. The last element is important because it allows the United States to argue that space was weaponized when the first ballistic missiles were developed, and is consistent with the concept of placing weapons in space. See DeBlois, Bruce M., "Space Sanctuary: A Viable National Strategy," *Airpower Journal*, 12 (1998), pp. 41-57; and Ziegler, David W., *Safe Heavens: Military Strategy and Space Sanctuary Thought* (Montgomery, AL: School of Advanced Airpower Studies, Air University Press, June 1998).

[10] *Air Force Doctrine Document-1*, Headquarters Air Force Doctrine Center, Maxwell AFB, AL (1997), p. 30. Also, Grossman, Karl, "Master of Space," available at: (http://www.progressive.org/gros001.htm, November 7, 2000).

[11] White House Fact Sheet, *National Space Policy* (Washington D.C.: Government Printing Office, 1996).

[12] "Update on Satellite Jamming," (http://www.ib.be/med/med-tv/sterka/issue03/jamupdat.htm, October 8, 2000).

[13] Myers, Richard B., "Space Superiority is Fleeting," *Aviation Week and Space Technology,* January 1, 2000.

[14] *Report of the Commission to Assess United States National Security Space Management and Organization* (http://www.space.gov, 2001), pp. 22, 25.

[15] McDougall, Walter A., *…The Heavens and the Earth: A Political History of the Space Age,* (New York, 1985), p. 134, in which the policy was to "shield spy satellites and other military systems to support the deterrent, provide accurate intelligence, prevent the military from going "hog-wild," and monitor hoped-for arms control accords." (p. 227)

[16] *Ibid*., pp. 227-228.

[17] White House Fact Sheet, *National Space Policy*, p. 1, which notes that, "The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all humanity…Peaceful purposes allow defense and intelligence-related activities in pursuit of national security and other goals…Purposeful

interference with space systems shall be viewed as an infringement on sovereign rights."

[18] White House Fact Sheet, *National Space Policy*, p. 7. According to the Department of Defense portion of the national policy states, "Consistent with treaty obligations, the United States will develop, operate and maintain space control capabilities to ensure freedom of action in space and, if directed, deny such freedom of action to adversaries. These capabilities may also be enhanced by diplomatic, legal or military measures to preclude an adversary's hostile use of space systems and services. The U.S. will maintain and modernize space surveillance and associated battle management command, control, communications, computers, and intelligence to effectively detect, track, categorize, monitor, and characterize threats to U.S. and friendly space systems and contribute to the protection of U.S. military activities."

[19] For further discussion, see Johnson-Freese, Joan, "The Viability of U.S. Anti-Satellite (ASAT) Policy: Moving Toward Space Control," (Colorado Springs, CO: USAF Academy, Institute for National Security Studies, 2000).

[20] The attack against Pearl Harbor, which is used by many current space enthusiasts to argue that the United States should actively pursue space control, is mentioned in articles about protecting the United States electronic information infrastructure.

[21] Muolo, Michael J., Air *University Space Handbook: A War Fighter's Guide to Space* (Montgomery, AL: Air University Press, 1993), p. 32.

[22] Johnson-Freese, Joan, "The Viability of U.S. Anti-Satellite (ASAT) Policy: Moving Toward Space Control," p. 18.

[23] *Report of the Commission to Assess the Ballistic Missile Threat to the United States*, http://www.usinfo.state.gov/topical/pol/arms/addreads.htm, July 15, 1998.

[24] White House Press Release, "President Clinton signs the National Missile Defense Act of 1999" (Washington, D.C.: Government Printing Office, 1999).

[25] Plafker, Ted, "China Joins Russia in Warning U.S. on Shield," *Washington Post*, July 19, 2000, p. A1.

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[26] Scott, William B., "Wargames Zero In On Knotty Milspace Issues," *Aviation Week and Space Technology*, January 29, 2001, pp. 53-55.

[27] *National Space Policy.*

[28] Friedman, Thomas L., *The Lexus and the Olive Tree* (New York, 2000).

[29] Toffler, Alvin and Heidi, *War and Anti-War* (New York: Warner Books, Inc., 1993).

[30] See *National Security Strategy* (Washington, D.C.: White House, 1992, 1999).

[31] *A National Security Strategy for a New Century* (Washington, DC: White House, 1999), pp. 6-21; *A National Security Strategy for a Global Age* (Washington, DC: White House, 2000), pp. 9-30. See also Miller, Dennis, and Stocker, John, *Commercialization of Space Systems: Policy Implications for the United States* (Montgomery, Alabama: Occasional Paper, Air War College Center for Strategy and Technology, Maxwell Air Force Base, 2001).

[32] *Joint Vision 2020* (Washington D.C.: Joint Chiefs of Staff, 2000); *National Military Strategy* (Washington D.C.: Joint Chiefs of Staff, 1998), pp. 8-10, 28-30.

[33] Santoli, Al, "Beijing Describes How to Defeat U.S. in High-Tech War," *China Reform Monitor*, July 24, 2000, http://www.afpc.org/crm/crm331.htm. See also Tom Wilson, *Threats to United States Space Capabilities* (Washington D.C., 2001), http://www.space.gov

[34] *State of the Space Industry, 2000* (Bethesda, MD: Space Publications, 2000), p. 17.

[35] Haller, Linda L., and Sakazaki, Melvin S., Commercial *Space and United States National Security* (Washington D.C., 2001), p. 7, http://www.space.gov, which was written as a support paper for the Commission to Assess United States National Security Space Management.

[36] *Space Imaging Corporate Overview*, http://www.spaceimaging.com/aboutus/overview4.htm.

[37] *Update on Satellite Jamming*, http://www.ib.be/med/med-tv/sterka/issue03/jamupdaat.htm

[38] "Robot Camera on Mir abandoned after malfunction," Special CNN Report, http://www.cnn.com/TECH/9712/17/mir.camera.snag/index.html and "X-Mir Inspector Mission," http://www.geocities.com/~iklsld/inspector.htm

[39] *State of the Space Industry, 2000*, p. 17.

[40] *Statement by the President Regarding the United States Decision to Stop Degrading Global Positioning System Accuracy* (Washington, D.C.: The White House, May, 2000).

[41] A similar path was taken when the Defense Meteorological Satellite Program (DMSP) and the Department of Commerce combined to form the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) under the Department of Commerce.

[42] *Report of the National Commission for the Review of the National Reconnaissance Office*, (Washington D.C., 2000). See http://www.nrocommission.com; and *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington D.C., 2001), http://www.space.gov.

[43] Each U.S. President identifies the vision or course that is believed to be best for the nation, which obviously changes with different presidential administrations.

[44] Office of Science and Technology Policy, *National Science Foundation Data Table 4-15* (Washington, D.C.: White House, 1999).

[45] National Science Board, *Science and Engineering Indicators, 2000* (Washington D.C., 2000), pp. 4-17.

[46] Gray, Colin S. *Modern Strategy*, p. 28, "Strategic culture consists of the socially constructed and transmitted assumptions, habits of mind, traditions and preferred methods of operations--that is, behavior--that are more or less specific to a particular geographically based security community."

[47] A support paper for the Commission to Assess United States National Security Space Management provides a good historical review and solid recommendations for establishing a military space culture. See McLaughlin, J. Kevin, "Military Space Culture" (Washington, D.C., 2001), http://www.space.gov. See also *Report of the Commission to Assess*

United States National Security Space Management and Organization (Washington D.C., 2001), p. 42, http://www.space.gov.

48 White House Fact Sheet, *National Space Policy*, p. 1.

49 *Ibid*.

50 *Department of Defense Space Policy* (Washington D.C., 1999). http://web7.whs.osd.mil/text/d310010p.txt, December 3, 2000.

51 See Miller, Dennis, and Stocker, John, *Commercialization of Space Systems: Policy Implications for the United States* (Montgomery, Alabama: Occasional Paper, Air War College Center for Strategy and Technology, Maxwell Air Force Base, 2001.

52 *Report of the National Commission for the Review of the National Reconnaissance Office*, (Washington D.C., 2000), http://www.nrocommission.com.

53 *Strategic Plan 2000* (Washington D.C.: NASA Headquarters, 2000), http://www.nasa.gov.

54 *Space Launch Modernization Plan* (Department of Defense, 1994), p. 8.

55 *Spacelift 2025: The Supporting Pillar for Space Superiority* (Air University Press, 1996), pp. 18-20.

56 See Ward, John, "Space Operations Vehicles: Military and Commercial Applications," in Martel, William C., *The Technological Arsenal* (Washington, D.C.: Smithsonian Institution Pres, 2001), pp. 153-172.

57 "EELV Program Overview and Status," http://www.losangeles.af.mil/SMC/MV/eelvhome.htm, November, 2000). The goals of the NASA Second Generation of Reusable Launch Vehicles were to, "…substantially reduce the technical and business risks associated with developing safe, affordable, and reliable reusable launch vehicles…specific goals are to…decrease the cost tenfold to approximately $1000 per pound of payload." See "Space Launch Initiative: 2nd Generation Reusable Launch Vehicles," (Huntsville, AL: Marshall Space Flight Center, 2000), http://std.msfc.nasa.gov/2ndgen/2ndgenindex.html.

[58] *Department of Defense Assessment of Space Launch Failures* (Washington, D.C.: Department of Defense, 1999). http://www.af.mil/lib/misc/spacebar99b.htm.

[59] *Lean Aerospace Initiative* (Cambridge, MA: Massachusetts Institute of Technology, 2000), http://lean.mit.edu/public/index.html.

[60] Butterworth, Robert L., *Growing the Space Industrial Base: Policy Pitfalls and Prospects* (Montgomery, AL: Maxwell Air Force Base, Air University Press, 2000), p. 1, who notes that, "The Defense Department has long hoped that its needs for space products and services could be supplied by an industrial base that is sustained by commercial sales. That date has not yet arrived despite years of targeted purchases, investments, and acquisition reform…Future programs are likely to achieve innovation and cost control in the same way that past programs did—through active government participation and managed competition." See also Klotz, Frank G., *Space, Commerce, and National Security* (New York: Council on Foreign Relations, 1998), who argues that, "the existence of a robust and dynamic commercial space industry is essential to retaining American leadership in space and, by extension, its ability to protect its interests there in the future."

[61] A good resource is Muolo, Michael J., *Air University Space Handbook: A War Fighter's Guide to Space* (Montgomery, AL: Maxwell Air Force Base, Air University Press, 1993), which includes a number of useful references in the notes that review the different space organizational structures historically used by the United States.

[62] *Ibid*., p. 62. See also White House Fact Sheet, "U.S. National Space Policy" (Washington D.C., 1989).

[63] To succeed, the National Space Council must include cabinet-level individuals, such as the secretaries of state, defense, commerce, treasury, transportation, and energy, as well as the director of central intelligence, national security advisor, the director of the Office of Management and Budget, and the director of the National Aeronautics and Space Administration, the Chairman of the Joint Chiefs of Staff, the service secretaries, and industry leaders.

[64] *Report of the National Commission for the Review of the National Reconnaissance Office* (Washington D.C., 2000), p. 77,

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http://www.nrocommission.com. "The Commission concludes that the National Reconnaissance Office demands the personal attention of the President of the United States, the Secretary of Defense and the Director of Central Intelligence. It must remain a strong, separate activity, with a focus on innovation, within the Intelligence Community and the Department of Defense."

[65] *The Commission to Assess United States National Security Space Management and Organization: Executive Summary* (Washington D.C., 2001), http://www.space.gov/commission/report.htm

[66] Gray, Colin S. *Modern Strategy*, pp. 36

[67] Headquarters 14th Air Force, *Weapons and Tactics Primer: Initiative and Independence in Space Combat* (14th Air Force, 2000).

[68] Campen, Alan D., *The First Information War* (Fairfax, VA. 1992); Merrill A. McPeak, *Aviation Week & Space Technology*, 1991.

[69] Gray, Colin S. *Modern Strategy*, p. 36, suggests that strategic theory "educates the mind by providing intellectual organization, defining terms, suggesting connections among apparently disparate matters, and offering speculative consequentialist postulates." He continues to describe strategic doctrine as stating beliefs and teaching "what to think and what to do, rather than how to think and how to be prepared to do it."

[70] Author interview, Air Force Laboratories at Kirtland Air Force Base, Albuquerque, New Mexico.

[71] Kandebo, Stanley W., "Landmark Tests Boost Scramjet's Future," *Aviation Week & Space Technology*, March 26, 2001, p. 58.

[72] *Ibid*.

[73] Mantz, Michael R., The *New Sword: A Theory of Space Combat Power* (Montgomery, AL: Air University Press, 1995).

[74] *Ibid*., p. 60.

[75] Gray, Colin S. *Modern Strategy*, pp. 41.

[76] Dolman, Everett Carl, "Astropolitics and Astropolitik: A Geopolitical Framework for Outer Space Strategy," Presentation to Political Science Association, Boston, 1999. "The excesses and pseudo-science of the

German school of *Geopolitik* must be avoided, and the use of the term *astropolitik* is intended as a constant reminder of the failures of combining military and political strategy with perverse imperatives of Social Darwinism." (p. 32)

[77] *Ibid*.

[78] For thoughts on integrating civil and military space activities see a supporting paper to the Commission to Assess United States National Security Space Management, see Seftas, Randy, *The Civil Space Sector* (Washington D.C., 2001). http://www.space.gov.

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